9.1 (continued) Subtracting Vectors

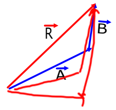
Opposite of a vector:

Given a vector A. The opposite of $\vec{A}$ denoted by $-\vec{A}$ is a vector with the same magnitude of $\vec{A}$, acting in the opposite direction.

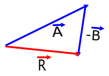
Defn: $$\vec{A} - \vec{B} = \vec{A} + \left(-\vec{B}\right)$$

Ex 1. $\vec{A} + \vec{B}$

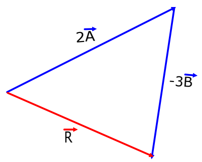
...Using the Tail-to-Head method...



Ex 2. $-\vec{A} = \vec{B} + (-\vec{A}$ $\vec{B}$



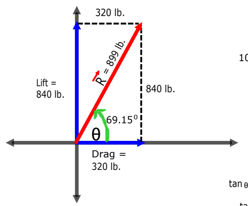
Ex 3. 2 $-\vec{A} = 3\vec{B} + (-3\vec{A})$ $\vec{B}$



*make drawing
*find resultant vector
*use pythag to find distance of R
*use tan to find theta of the vector to find total vector (magnitude and direction)

P. 263, #37 ...application

Two forces that act on an airplane wing are called the lift and the drag. Find the resultant of these forces scting on the airplane wing in fig 9.10



$a^2 + b^2 = c^2$

$320^2 + 840^2 = c^2$

$102400 + 705600 = c^2$

$808000 = c^2$

$898.888 = c$

$899 \approx$

$\tan\theta = \frac{840}{320}$

$\tan\theta = 2.625$

$\tan^{-1}(\tan\theta) = \tan^{-1}(2.625)$

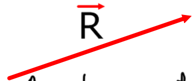
$\theta = 69.1455^0$

Rationale - To find the complete resultant:
-represent graphically (Draw a Picture!!!)
-find distance of resultant (magnitude)
-find measure of q for resultant (direction)

End of 9-1...HW assignment ... #9, 11, 17-33 every other odd (graph paper helps)

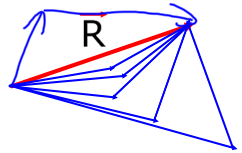
9.2 Components of Vectors

Question: How many vector pairs, when added graphically, produce the resultant vector $\vec{R}$ shown below?



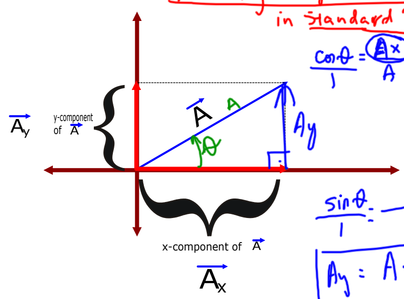
Components: Any two vectors whose sum is the given vector.

Answer: An infinte number of vector pairs can produce $\vec{R}$!



Therefore, for the following section, we will only concern ourselves with vectors in standard position, as shown below with vector $\vec{A}$.

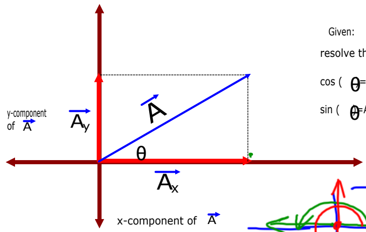
x- and y- components of a vector in Standard Position



$\frac{\cos\theta}{1} = \frac{A_x}{A}$ $A_x = A \cdot \cos\theta$

$\frac{\sin\theta}{1} = \frac{A_y}{A}$ $A_y = A \cdot \sin\theta$

Resolving a vector - means to determine the x and y components of $\vec{A}$ in Standard Position

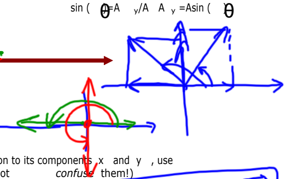


Given: $\vec{A}$, θ

resolve the vector

$\cos(\theta) = A_x/A$ $A_x = A\cos(\theta)$

$\sin(\theta) = A_y/A$ $A_y = A\sin(\theta)$



***Therefore, to resolve any vector in standard postion to its components x and y, use the following formulas, memorize them! (But...do not *confuse* them!)

$\vec{A}_x = A\cos(\theta)$

$\vec{A}_y = A\sin(\theta)$

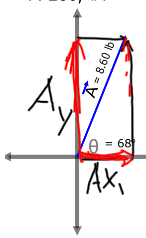
Note: The vector $\vec{A}$ must be in standard position.

9.2

Resolving Vectors: Examples

Note to students...Make a sketch!

P. 266, #7

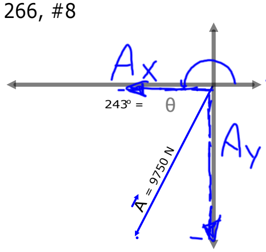


$A_x = 8.6(\cos(68°))$
$A_x = 3.22\,lb.$ $\theta_{A_x} = 0°$
$A_y = 8.6(\sin(68°))$
$A_y = 7.97\,lb.$ $\theta_{A_y} = 90°$

$A_x = A\cos(\theta)$
$= 8.6 \cos(68)$
$= 8.6 (0.3746)$
$\vec{A}_x = 3.2216$
$\theta_{A_x} = 0°$ ✓

$A_y = A\sin(\theta)$
$= 8.6 \sin(68)$
$= 8.6 (0.9272)$
$\vec{A}_y = 7.973$
$\theta_{A_y} = 90°$ ✓

P. 266, #8



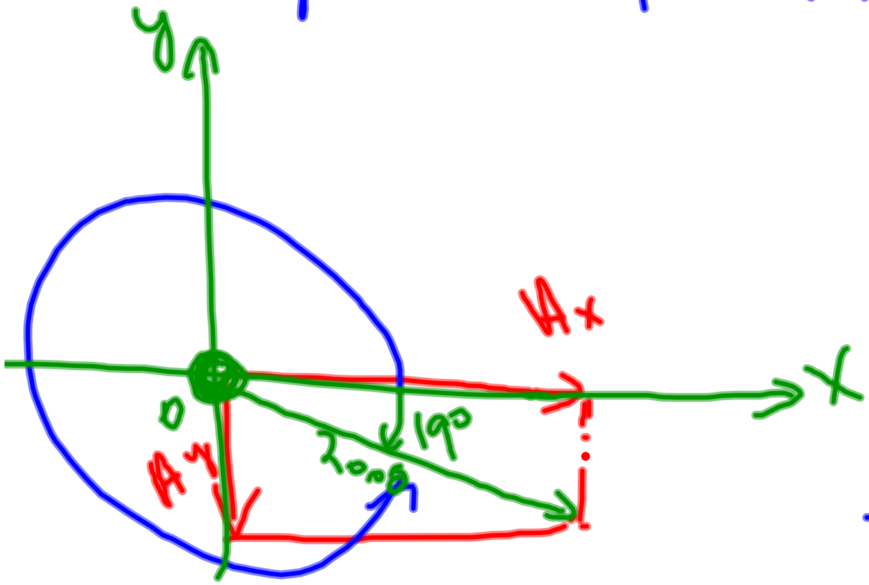
$A_x = 9750\,N(\cos 243)$
$A_x = -4426.4\,N$
$A_y = 9750(\sin 243)$
$A_y = -8687.3\,N$

$A_x = A\cos(\theta)$
$= 9750 \cos(243)$
$= 9750 (-0.4539)$
$\vec{A}_x = -4426.4$
$\theta_{A_x} = 180°$

$A_y = A\sin(\theta)$
$= 9750 \sin(243)$
$= 9750 (-0.891)$
$\vec{A}_y = -8687.31$
$\theta_{A_y} = 270°$

Finish 9.2.... HW is #1-19 odd

A force of 2000 lb is applied to a plane wing at an angle of 19° below the horizontal, to the right. Find the horizontal and the vertical components of this force.

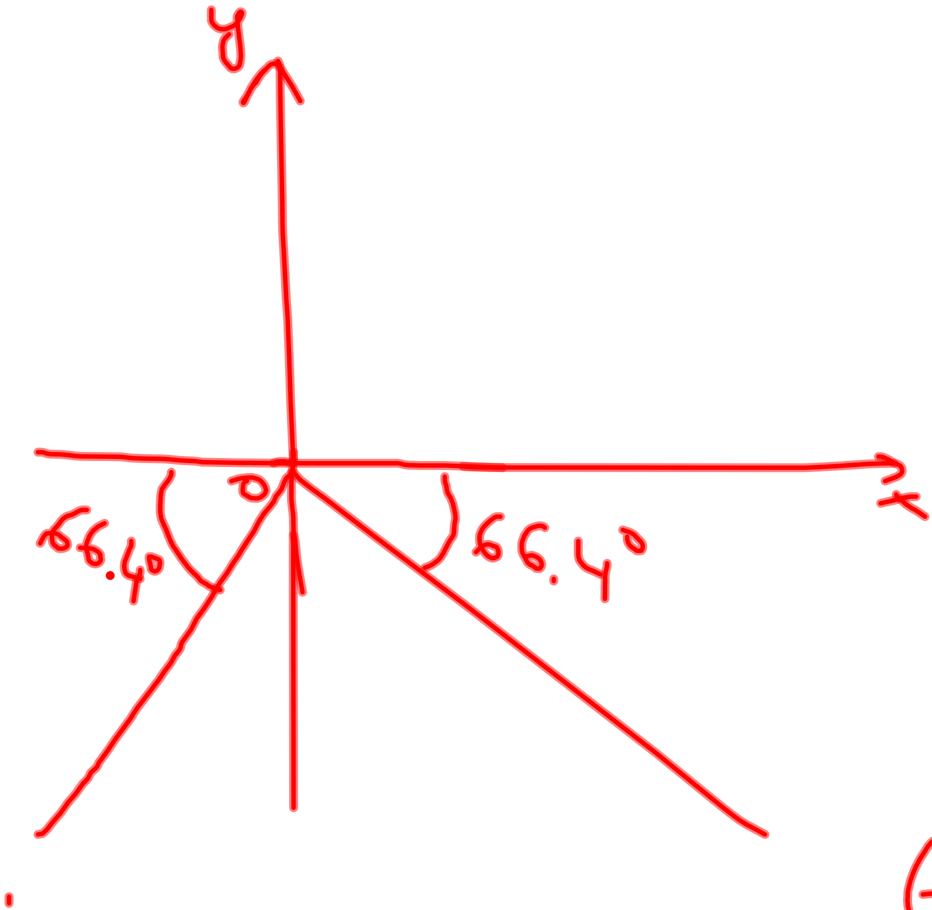


$\theta = 360° - 19° = 341°$

$A_x = 2000 * \cos 341° \approx 1891.04 \text{ lb}$

$A_y = 2000 * \sin 341° = -651.14 \text{ lb}$

$\theta_{A_x} = 0°$; $\theta_{A_y} = 270°$



$\theta = 180° + 66.4° = \underline{\underline{246.4°}}$

$A_x = 18 \cdot \cos(246.4)$

$A_x = -7.21\ ft/s$

$A_y = 18 \cdot \sin(246.4$

$A_y = -16.49\ ft/s$

$\theta A_x = 180°$ $\theta A_y = 270°$